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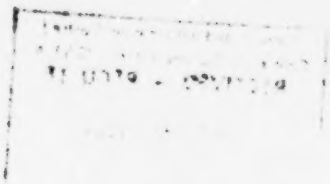
PROTECTIVE CONTAINER FOR WHEELCHAIRS

FIELD EVALUATION

Prepared for:
TRANSPORTATION DEVELOPMENT CENTRE
TRANSPORT CANADA

Prepared by:
DAVIS ENGINEERING LIMITED
CONSULTING ENGINEERS
OTTAWA, CANADA

SEPTEMBER 1982



The contents of this report reflect the views of the contractor, and not necessarily the official view or policies of the Transportation Development Centre.

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17. Abstract

This report documents the in-field evaluation of a prototype protective container for wheelchairs used in aircraft transit. Several containers were manufactured based on a prototype design developed by Davis Engineering under contract no. TDC 4504 with the Transportation Development Centre (TDC). With the cooperation of Air Canada and Canadian Pacific Airlines, these containers were then utilized during the trial transport of several wheelchairs to and from major centres on the airlines' routes. Comments from ramp attendants, damage to the wheelchairs and containers, and handling problems encountered during transit were documented at various stages of these trials. Following the initial trials, two modified containers underwent extended testing in order to determine their useful lives.

The study concludes that:

- the container concept is good from a protective and handling viewpoint,
- a tougher more tear resistant material (ie. synthetic) should be used in the construction of the bag,
- minor modifications should be made to the design of the bag (ie. aluminum tube rod end caps and relocation of certain velcro fasteners).

A cost effectiveness study was performed based on the test results.

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17. Resume

Ce rapport rend compte des travaux d'évaluation en service du prototype d'un emballage pour la protection des fauteuils roulants devant être transportés dans la soute des avions. Plusieurs emballages ont été réalisés d'après une idée développée par Davis Engineering, aux termes du marché TDC 4504 conclu avec le Centre de développement des transports (CDT). Grâce à la collaboration d'Air Canada et de CP Air, ces emballages ont été utilisés expérimentalement entre les principales villes desservies par ces compagnies. Tout au long de cette période d'évaluation, les divers commentaires obtenus des préposés aux aires de trafic, les avaries constatées aux fauteuils roulants et aux emballage eux-mêmes et les problèmes de manutention soulevés ont été dûment enregistrés. A l'issue de cette première évaluation, deux emballages modifiés ont été soumis à des essais supplémentaires en vue de déterminer leur durée de vie utile.

Le rapport arrive aux conclusions suivantes:

- l'emballage dans sa conceptuion actueele est acceptable du point de vue protection et facilité de manutention,
- un matériau plus tenace et plus résistant aux déchirures (matériau synthétique, par exemple) devrait être utilisé de préférence,
- des légères modifications devraient être apportées à la construction de l'emballage (e.g. modification des cahpeaux d'extrémité des montants en aluminium tubulaire et déplacement de certaines fixations velcro).

A partir des résultants de ces essais, une étude économique a été faite de ces emballages.

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Fauteuil roulant, emballage, manutention des bagages, transport aérien	Le CDT dispose d'un nombre limité d'exemplaires

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SUMMARY

This report documents the in-field evaluation phase of the development of protective containers for wheelchairs. Based on the prototype design, several small and large wheelchair containers were fabricated and distributed to Air Canada and C.P. Air. These containers were utilized during the transportation of several wheelchairs to and from major centres on the airlines' routes. The comments received from the various ramp attendants, recorded damage to both containers and wheelchairs, and handling problems encountered during transit were documented at various stages of these trials. In particular, the ramp attendants found that at least two persons were required to put the wheelchair into the container and to handle the unit from the ramp to the aircraft cargo compartment. Generally, the wheelchairs were not damaged during transit (with one exception). However, the material of which the containers were constructed was torn in several locations, especially near the stiffener rib ends. Other minor design problems included the positioning of certain velcro fasteners and tensioning cords.

Following the single use field trial of these containers, the members of the steering committee decided that a life cycle test should be conducted using two containers modified to remedy more obvious problems outlined in the initial tests (ie. inserts for the aluminum rod ends, and additional fastenings on the access door). Each of the modified containers was subjected to two round trips to various destinations before they were considered unserviceable, and they were then returned to Davis Engineering for evaluation.

In order to provide for a more accurate cost/benefit analysis, several canvas product manufacturers were requested to submit cost estimates for the fabrication of these containers in quantities of 50,100,500,1000, and 5000. This information was utilized to rework the original cost/benefit analysis contained in project no. TDC 4409.

From this analysis, it has been concluded that next to the current Air Canada practice of using a polyethylene bag to protect wheelchairs, the next most cost effective alternative available to the airlines is to have the passenger supply his/her own protective container for his/her own wheelchair. In order to make this container more cost effective, it is necessary to extend its life cycle by investigating more resilient bag materials (ie. synthetics), and to simplify the overall design (reduce number of carrying straps, velcro fasteners etc.).

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1.0 INTRODUCTION

Following the prototype build of the protective container for wheelchairs (TDC report No. TP 3491E)[1] a contract was awarded to Davis Engineering by the Transportation Development Centre (TDC) to test a number of these containers in a field evaluation. Tom Illing of Air Canada and Mike Symington of C.P. Air both agreed to undertake the in-field test for these units, enabling user feedback from a functional viewpoint.

From the comments received from the various ramp attendants of the two airlines, minor modifications were made on two small containers to rectify some of the more obvious recurrent shortcomings discovered during the initial testing. These two containers were then sent to Air Canada for an extended in-field test in order to determine their useful life cycles. The data generated by these tests was used to revise the original cost/benefit analysis done in the initial feasibility study under DSS contract No. TDC4409. Revised cost estimates have also been obtained for the construction of the final product containers, and have been incorporated into this analysis.

2.0 DESIGN, DEVELOPMENT, AND PRODUCTION OF CONTAINERS

At the Steering Committee meeting held on Thursday, February 4, 1982, following the demonstration of the prototype protective container for wheelchairs, a series of design modification suggestions was put forward by the committee members in order to improve the configuration of the container for in-field use.

The following is a list of the discussed modifications:

A. Widen the velcro fastening straps to 5 cm (2 inches)

B. Provide a larger carrying handle loop to facilitate use with bulky mitts, place handles at the front and rear of the container to permit end to end carriage.

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1 Nicklin, J.R., PROTECTIVE CONTAINER FOR WHEELCHAIRS - PROTOTYPE BUILD, Ottawa, Ontario; for the TDC of Transport Canada in Montreal - Final Report No. TP 3491E, January 1982.

C. use a brighter canvas colour to improve visibility (ie. yellow, orange or red).

D. use a lighter weight of canvas or thinner aluminum tube thickness to reduce the overall container weight.

E. extend the rib stiffeners more around the base and top of the bag.

F. remove the canvas pocket on the top of the container.

G. stitch the basic instructions onto the outside of the container

H. stitch a transparent plastic pocket on the outside of the bag for tag identification (per JPBC Agenda Item S document).

I. mark the containers with the appropriate "Transport Canada" logo, fragile symbol, and wheelchair or handicapped device symbol.

With the above modifications in mind, a revised protective container design was evolved for use with collapsible types of wheelchairs. A second design was defined which would accomodate various types and sizes of commercially available non-collapsible wheelchairs (ie. electric). Data used in determining these dimensions was gathered from a survey performed by the TDC of commercially available collapsible and non-collapsible wheelchairs. Basically, modifications outlined here included increasing the width of the container from 30 cm to 76 cm to allow for the increased lateral size, and increasing the widths of the door flaps in order to close in the wider rear access. Lengthened velcro fastening straps were also required across the rear and front of the container.

Two containers were then fabricated, one large and one small, in order to determine whether the original design criteria had in fact been met. With acceptance of these containers, the remainder of the order was then completed and delivered to Davis Engineering.

3.0 CURRENT HANDLING PRACTICES

In this segment of the study, present techniques for the airlines handling of the handicapped were examined. Both the airlines and the handicapped groups were invited to make comments on the three options proposed by Transport Canada, and to bring forward any suggestions which could be considered for alternative solutions to the previous options.

Most large metropolitan airports today have a type of bridge or bridging system which connects the airport terminal with the entrance door to the aircraft. This innovation in itself has simplified the embarkation/disembarkation of handicapped passengers in that wheelchairs can be wheeled directly up to the aircraft and, in most cases, may be taken right up to the passenger's seat. This procedure is the practice preferred by the airline since the handicapped person does not have to be transferred from one means of mobilization to another for entry into the aircraft, saving the airline personnel effort and time. When the passenger is transferred from his personal chair to his/her seat, his/her wheelchair is then taken back down the bridge to an exit door from the terminal to the tarmac, where it is wheeled to the cargo compartment of the aircraft. The wheelchair is usually the last piece of luggage to be loaded so that it is closest to the door in the cargo bay; thus, it is more easily retrieved for passenger disembarkation at his destination.

If the terminal is not equipped with the bridge system described above, the alternative method employed by the airline for handicapped passenger movement is as follows. The passenger is placed in a device called a "Washington Chair" at or near the entry ramp to the aircraft. The handicapped passenger and chair are then lifted on board the aircraft by the airline attendants, and wheeled to the passenger's seat where he/she is then transferred from the chair to the seat.

In the meantime, the passenger's personal wheelchair is taken to the cargo area of the aircraft and stored in a fashion similar to that described in the previous method.

At the present time, only Air Canada offers a system whereby the passenger's wheelchair is contained in a polyethylene bag when it is placed in the cargo hold of the aircraft. All other airlines contacted usually place the wheelchair in the hold either standing upright or lying flat (sideways) without a wrap or padding of any sort.

Transport of electric wheelchairs presents a multitude of problems to both the airline and the handicapped traveller. In the instance where the traveller will be flying on a wide-bodied aircraft, where baggage is containerized, the procedure is as follows. Upon arrival at the airport, the handicapped traveller is transferred from his electric chair to a conventional airline wheelchair. The electric wheelchair is then placed (with battery) into a container with other baggage in such a fasion that movement due to vibration or handling is minimized. The container is then sealed and stowed in the aircraft. The passenger is boarded in the same manner described earlier in this text. Thus, it may be seen that the handicapped traveller may have to be transferred at least once from wheel-chair to wheelchair prior to boarding.

The above methods constitute the greater majority of cases where-by the handicapped traveller is transferred from wheelchair to aircraft. Another less often used system includes the use of a lift type truck to raise the handicapped person to the aircraft door for boarding. This system may be used to unload a handi-capped person on a Washington chair when stairs to the aircraft may prove difficult to negotiate.

4.0 FIELD TESTS

Through the cooperation of T. Illing at Air Canada and M. Symington at C.P. Air, a field test of the protective containers was undertaken. A total of 10 containers (5 large and 5 small) were sent to Air Canada, and 6 small containers were delivered to C.P. Air. Activities pertaining to the institution of the containers into the operating procedures in each airline was left solely to the managers of the respective organizations with minimal influence from the contracting company. Demonstrations were given to both T. Illing and M. Symington on separate occasions to outline the procedures to be used for loading, unloading, and storing the containers.

The following is an outline of the procedures followed during the testing of these containers.

4.1 AIR CANADA

Upon receipt of the containers in Dorval at Air Canada, Gerry Schreindorfer gave a demonstration to the ramp attendants and baggage handlers on the use of the bag. In order to facilitate the use of the containers, instructions in both official languages were stitched on each bag in a visible location. Air Canada officials indicated that these instructions were in fact very beneficial to the ramp attendants who were responsible for the packing and unpacking of the wheelchairs.

In the actual field trial, several unclaimed wheelchairs were containerized, shipped to a destination on some of the airline's more major routes, and unloaded. The ramp attendant at the destination was requested to remove the wheelchair from the container, inspect the condition of both the wheelchair and the container, replace the wheelchair inside the bag, and return the unit to the point of origin (Air Canada at Dorval).

He was also requested to immediately contact the baggage manager at the point of origin of the container and report:

a. condition of the wheelchair and container
b. any problems which he (the attendant) encountered while handling the wheelchair-container combination
c. any problems encountered while removing or inserting the wheelchair into the container
d. any possible modifications which could be made to the container to facilitate handling or improve durability and function.

All comments were documented by Gerry Schreindorfer of Air Canada.

4.2 C.P. AIR

The 6 small containers were delivered to Mike Symington at Ottawa Uplands airport, where a demonstration of the operation of the bag was performed. These containers were then equally divided between C.P. Air's Toronto and Vancouver branch offices for in-field testing. Ramp attendants were alerted to the in-field test being undertaken, and were requested to use the containers when possible, and to return them to the point of origin with their comments. The information given was similar to that outlined for Air Canada (see Appendix C).

4.3 TEST RESULTS

From the in-field tests undertaken by both airlines, very similar responses were received from the ramp attendants in almost all cases, a listing of the most predominant ones follows:

A. the rear access doors did not fully close, and therefore loose articles contained inside the bag were vulnerable to falling out
B. when installed on a wheelchair, the container required two persons for handling.

C. the canvas material appeared to be too light and was susceptible to abrasions and tears.

D. the ends of the aluminum tube ribs were causing the canvas to tear at the front end of the container, and were protruding at the rear under certain loading conditions.

E. ramp attendants generally agree that it would be more convenient to have a one size container to fit all types of wheelchairs.

4.4. LIFE CYCLE TESTS

Based on the more obvious problems encountered listed in Section 4.3, a decision was made by the members of the steering committee to rectify the more predominant problems with the container, and to proceed with an extended field investigation to determine the life expectancy of these units. Two of the already used units were modified in an attempt to reduce abrasions to the canvas due to the sharpness of the rib ends (rubber ends were inserted), and the rear closure was modified for more positive closure (additional velcro along the edge of the door). Air Canada's G. Schreindorfer agreed to undertake an extended in-field trial of these two containers, and return them to Davis Engineering for final evaluation.

5.0 OBSERVATIONS AND ANALYSIS

In general, comments received from both airlines have indicated that the reinforced bag concept has considerable merit in its function. Good protection is afforded the wheelchair both from lateral impacts, and from the elements (weather). However, the major problems associated with this design include:

A. the rear access door does not positively close, loose components contained in the bag are in danger of falling out

B. the canvas material of which the bag is constructed is vulnerable to tears and abrasion

As a consequence of using canvas for the bag material, the projected life cycle of the container was found to be limited. This was evident from the extended life cycle study which lasted only two additional return trips per container. The containers, upon return to D.E., were evaluated as being serviceable, with the total life cycle being at least twice the number of tested cycles performed, or 6 return trips (12 single uses).

From a durability viewpoint, the wheelchair is protected from most minor impacts, scrapes, and from damages which may occur as a result of stacking wheelchairs on top of each other. However, under severe impact loads such as a direct drop onto the wheels in an upright position from a height of at least one meter, more major structural damages to the wheelchair will occur. In this regard, this container is not capable of providing protection from adverse loading conditions, but is able to reduce minor damages which may be inflicted upon the wheelchair during handling.

In order to improve the overall design concepts, and extend the service life of this container, the following modifications should be made to the existing unit:

A. the stiffener ribs should have rounded inserts pressed into their ends to reduce damage to the canvas due to sharp edges
B. alternate materials used in the construction of the bag should be investigated in order to increase strength and tear or abrasion resistance.

6.0 COST/BENEFIT ANALYSIS

With the construction of these prototype containers, more concrete life cycle data and costs per unit prices have become available. It has therefore been decided that an updated cost/benefit analysis should be included in this report, similar to the analysis contained in the original "Protective Containers for Wheelchairs - Feasibility Study" under contract No. TDC 4409.

Since Air Canada is the only airline which currently utilizes a container for wheelchairs (ie. polyethylene bag), costs for disposable containers shall be based upon their experience. An additional option shall also be investigated wherein the handicapped traveller purchases his/her own reusable protective container for his/her own wheelchair for use when travelling by air or rail.

The following analysis estimates the costs of each option based on a cumulative single payment using present values effective September 1982 over a life cycle of 10 years. The options considered are:

A. Option #1(a) continue with Air Canada's method of utilizing a disposable polyethylene bag as a disposable container for wheelchairs.

   Option #1(b) continue with standard airline practice without using any protective containers

B. Option #2(a) use the presently designed reusable protective container for wheelchairs, purchased by the airline.

   Option #2(b) use the same protective wheelchair as in Option #2(a) but the handicapped traveller supplies his/her own container.

C. Option #3(a) use of loaned wheelchairs rented by the

airlines for the handicapped traveller

Option #3(b) use of loaner wheelchairs owned by the airlines.

This analysis is being performed as a cost benefit from the viewpoint of the airlines. The assumptions pertaining to this study are:

1. The total annual transported wheelchairs = 4000
2. Man-hours required for boarding a passenger with his wheelchair = .25 hours; for wheelchair = .10 hours (using disposable container, polyethylene bag) = .20 hours for reusable container
3. Man-hours required for disembarking passenger with wheelchair = .66 hours; for wheelchair = .10 hours (.20 hours for reusable container)
4. Cost for a standard collapsible wheelchair = $700.
5. Number of airports processing wheelchairs = 40
6. Each airport requires at least 5 containers (reusable) or wheelchairs depending on the option studied.
7. The cost per disposable container (polyethylene bag) = $2.00, the cost for a reusable container = $135., and $158. for the synthetic container (these estimates are based on: a. Air Canada's present bag costs and b. costs of container by Ottawa based fabricator for two material types
8. One (1) trip consists of one embarkation plus one disembarkation
9. Labour costs for ramp attendants are approximately $12.00/hour.
10. The average time spent at the destination is two consecutive days.
11. A disposable container (polyethylene bag) can be used only once.
12. The reusable container may be used for 15 one way trips (if constructed from canvas), and may be reused 40 times if constructed from a synthetic material.

13. The reusable container takes about the same amount of time to use as the disposable container. However, 2 personnel are required to handle the unit onto the aircraft.
14. In the life cycle analysis for 10 years, the assumed interest rate is 16%, and the inflation rate is 10%. The cumulative single payment present value factor is 7.554.
15. Assume that salaries and materials costs will keep pace with the escalation trends of 13% per annum
16. Annual cost for repairs to wheelchairs = $2000. with or without polyethylene containers. Costs with protective containers = $1000.
17. The average life expectancy of a rental or loaner wheelchair is 10 years.
18. A wheelchair costs $5.00/day to rent, and $2.00/day to store.

Option #1.(a) CURRENT PRACTICE OF WHEELCHAIR HANDLING
(Includes use of polyethylene bag)

MANPOWER:

Loading	.35 Hrs. Passenger	+	.10 Hrs. Wheelchair	=	.45 Hrs
Unloading	.76 Hrs Passenger	+	.10 Hrs Wheelchair	=	.86 Hrs

Total Labour = 1.31 Hrs

Labour costs: 1.31 Hrs x $12.00/hr = $15.72 Trip

Annual Labour Costs: $15.72/trip x 4000 trips = $62,880.00

MATERIALS:

Container costs per annum: $2.00 x4000 = $8,000.00

Costs of repairs to wheelchairs per annum = $2,000.00

Annual Material Cost = $10,000.00

Total Annual costs	=	$ 72,880.00
Cumulative Single payment: $72,880. x 7.554	=	$550,536.00

Present day cost per trip:

Labour:	$15.72
Materials:	$ 2.00
Repairs - Wheelchairs:	$ .50
Total Trip Costs	$18.22

Option #1(b): This option is virtually the same as option #1(a), except that the handling is done without the use of a protective container for wheelchairs.

MANPOWER:

Loading	.35 Hrs.
Unloading	.76 Hrs.
Total Labour	1.11 Hrs.

Labour Costs 1.11 Hrs x $12.00/Hr = $13.32/trip

Annual labour costs: $13.32/trip x 4000 = $53,280.00

MATERIALS:

Cost of repairs to wheelchairs	= $ 2,000.00
Total Annual Cost	= $55,280.00
Cumulative single payment: $55,280 x 7.554	= $417,585.00

Present day cost per trip: $55,280.00 /4000 = $ 13.82

OPTION # 2(a) Use of protective container purchased by the airline.

MANPOWER:

Loading	.35 Hrs (Traveller)	+	.20 Hrs (2 men/wheelchair)	= .55 Hrs
Unloading	.76 Hrs (Traveller)	+	.20 Hrs (2 men/wheelchair)	= .96 Hrs
Total Labour:				1.51 Hrs

Labour cost per trip: 1.51 Hr x $12.00/hr = $ 18.12
Annual labour costs: 18.12 Hr x 4000/trips yr. = $72,480.00

MATERIAL:

Initial No. of containers required:
40 airports x 5 containers/airport = 200
Cost: 200 x $135.00 = $27,000.00

No. of uses = 200 x 15 = 3000 uses require an additional 1000/15 = 67 containers
Cost: 67 x $135.00 = $9,045.00
Annual containers costs: $27,000 + $9,045. = $36,045.00
Annual cost of repairs: = $1,000.00
Total Annual Costs: = $109,525.00
Cumulative Single Payment: $109,525. x 7.554 = $827,352.00

Present cost per trip: $109,525.00/4000 = $27.38

For Synthetic Container:

INITIAL COST:

40 airports x 5 containers/airport x $158.00/container
x .974 (CSPF first year) = $ 30,778.00

ANNUAL COSTS FOR MATERIALS:

200 x $158.00/2 = $15,800.00
costs for repairs = $ 1,000.00
∴ Total annual costs $72,480 + $16,800 = $ 89,280.00

Cumulative present day single payment = $89,280.00 x 7.554
= $674,421.00

Adjustment for first two years initial purchase:

Cost for first 2 years = $15,800 x 1.848 = $29,198.00
Capital cost for first year = $30,778.00
Difference: $30,778.00 - $29,198.00 = $1,580.00
∴ Total cumulative single payment = $674,421.00 + $1,580.00
= $676,001.00

∴ Present Cost per trip = $676,001.00/40,000 = $16.90

OPTION #2(b) This option is identical to option #2(a) except the traveller bears the cost of the protective container.

MANPOWER: See option #2(a)

Labour cost per trip	$18.12
Annual Labour Costs:	$72,480.00

MATERIAL:

Annual cost of repairs:	$1,000.00
Total annual cost:	$73,480.00
Cumulative single payment- $73,480.00 x 7.554	$555,068.00

Present day cost per trip: $18.37

OPTION #3(a) Airline Provides Loaner Wheelchairs(Rented)

MANPOWER:

Same as Option #1(b)

Annual labour costs: $53,280.00

MATERIALS:

Assume for this option that there are no associated costs to repair wheelchairs.

Annual Rental Costs: 4000/2 x $5.00/day x 2 days
(Only require a wheelchair at destination) $20,000.00

Annual Storage Costs: 4000/2 x $2.00/day x 2 day
(Only require storage at departure) $ 8,000.00

Annual Total Materials Cost: $28,000.00

Total Annual Costs: $81,280.00

Cumulative single payment: $81,280 x 7.554 $613,989.00

Present day cost per trip: $81,280/4000 $20.32

OPTION #3(b) Airline Provides Loaner Wheelchairs (Airline owned).

MANPOWER:

Same as option #1(b)

Annual Labour costs: $53,280.00

MATERIALS:

Initial wheelchairs cost:

40 airports x 5 wheelchairs/airport x $700./wheelchair = $140,000.00

Annual replacement/repair cost: $1,400.00 (1% of original cost)

Annual storage cost:

4000/2 x $2.00/day x 2 days $8,000.00

Total Annual material costs: $162,000.00

Total First Year costs: $215,280.00

Cumulative single Payment

($215,280.00 - $140,000.00) x 7.554 = $568,665.00

plus original investment + $140,000.00

$708,665.00

Present day cost per trip:

$708,665.00/40,000 trips = $17.71

(4,000 trips/yr. x 10 yrs.)

This assumes that there are no recuperative costs for wheelchairs at the end of 10 years.

	Option #1(a) Air Canada Present Practice	Option #1(b) Other Airlines Present Practice	Option #2(a) Use Reusable Containers, Airline Owned	Option #2(b) Use Reusable Container Customer Owned	Option #3(a) Airline provide rented wheelchair	Option #3(b) Airline provide owned wheelchair
Average Cost per one way trip	$18.22	$13.82	$27.38 ($16.90)*	$18.37	$20.32	$17.71
PV of 10 yr Life Cycle	$550,536.00	$417,585.00	$827,352.00 ($676,001.00)*	$555,068.00	$613,989.00	$708,665.00

* Note: These prices are for the container constructed from synthetic material.

TABLE #1 - REVISED COST/BENEFIT ANALYSIS

7.0 DISCUSSION

In the cost/benefit analysis (summarized in Table #1) certain assumptions outlines in section 6.0 may be considered somewhat unrealistic, when viewed by either the airlines or the disabled travellers. One assumption of such a dubious nature concerns the value obtained for the annual costs for repairs to wheelchairs which was provided by the airlines. It must be remembered that this cost does not take into account the types of damages which are only detected when the handicapped traveller finally arrives at his home or destination, and which are then repaired at the individual's expense.

In addition to these less obvious breakages, are the immediately apparent damages which must be repaired in order to permit the disabled traveller to continue with his/her voyage, causing inconvenience to the individual. It is impossible to provide a dollar value to compensate for the problems befalling the disabled traveller arising from his/her temporary loss of a personal wheelchair. In particular, the loss of a personal wheelchair may incur additional expenses due to an unintended extension in trip length to allow for the extra time required for repairs, or the inconvenience of having to use an unfamiliar rental unit until the original can be repaired. Certain types of wheelchairs cannot be readily supplied by rental agencies, which may further incapacitate the handicapped traveller upon temporary loss of his/her own wheelchair (ie. double left or right hand drive, front instead of rear larger wheel, height of backrest, etc.). These undetermined values certainly contribute to a greater appreciation for the need for some protective device for wheelchairs undergoing transit from one terminal to another, but do not provide a monetary means by which to determine their

economic viability. In this cost/benefit analysis, the values used for determining airlines costs per movement have therefore been derived solely on a feasible or projected reduction in cost for repairs, and disregards the human aspect encompassing inconveniences and interrupted travel arrangements.

Another value used in the analysis which may be disputed concerns the number of movements which each container may be capable of sustaining before its useful life has ended. The containers tested for life cycle endurance were returned after 4 trips each for our evaluation. It was discovered that, apart from minor abrasions or slight tears, the containers as a whole were in very good condition structurally, and functionally. In addition to these 4 trips, each container had already been used for 2 trips on a prior trial performed by the same airline, making a total number of 6 trips per container. From the in-field evaluation, it was determined that these containers would be able to withstand at least two to three times the amount of usage already undergone, the number decided upon being 15 trips. The projected life cycle for a similar container constructed from a synthetic material was estimated to be about three times that for the canvas container, or 40 trips per container.

From Table #1 which summarizes the revised cost/benefit analysis based on updated cost estimates for protective container fabrication, it may be seen that the airline-owned container option #2(a) is not cost effective from the airline's viewpoint. However, if the passenger provides his/her own container to transport his/her own wheelchair, the option #2(b) shows that the cost per trip or extended PV life cycle based on 10 years compares very favourably with Air Canada's current handling

costs (within 1% of these costs). This airline has also indicated that if travellers provided their own containers similar to this design, Air Canada would accept responsibility for its use, and would undertake to train their personnel in its proper operation. Even if the life of the containers should be considerably extended, the airline owned protective container option is still not as cost effective as their current handling practices. However, this option in comparison with either of options #3(a) or #3(b) is the more desirable since the handicapped traveller requires his/her own wheelchair at his/her destination, and therefore considers an alternate wheelchair only as a last resort.

Economically speaking, therefore, in order to make the protective container more attractive to the airlines, the following steps should be followed:

a. the useful life of the container should be extended at least threefold. This may be accomplished by using synthetic bag material instead of canvas.
b. the manufacturing costs should be reduced by simplifying the overall design (ie. one elastic rope only, fewer carrying handles, reduce number of velcro fasteners used)
c. minimize the amount of financial involvement of the airlines by either offering these containers to the handicapped traveller as a rental or a purchased item.

8.0 CONCLUSIONS

As a result of the tests undertaken through the cooperation of Air Canada and C.P. Air, the following conclusions have been derived:

a. these containers do protect the wheelchairs in all but the most severe impacts
b. the canvas material is not sufficiently durable for this application, thus more tear resistant synthetics should be investigated
c. the configured design should be simplified to reduce fabrication costs, and minimize handling and operational problems.

APPENDIX A

MINUTES OF STEERING COMMITTEE MEETING

February 11, 1982

WHEELCHAIR CONTAINER PROJECT - PHASES 2 & 3

MINUTES OF MEETING NO. 3

AGENDA ITEM

1. The meeting was called to order at 10:10 am. Minutes of the second meeting were reviewed and accepted as written.

2&3 Messrs. Bosik and Nicklin of Davis Engineering tabled a draft copy of their final report on the "Prototype Build" phase of the reusable wheelchair container project and copies were distributed to members. Following a few summary remarks on the evolution of the final design, documented in section 3 of the report, pages 9 to 16, Mr. Nicklin proceeded to describe features of the prototype unit built from concept "E". He stated that the water repellant, preshrunk flexible canvas bag container, with nylon rope, handles and strapping and stiffener ribs made of light tubular aluminum weighed 6 1/2 pounds. A more detailed description is documented on pages 17 to 19 of the report along with a drawing on page 16. A series of colour polaroid photographs, mounted on two sheets, illustrates the sequence of steps required to insert the wheelchair into the container ready for handling as baggage. (Photographic copies of photo's were included in the descriptive literature accompanying the meeting agenda).

Mr. Nicklin proceeded to demonstrate the application of the prototype canvas bag container using a standard collapsible wheelchair brought for that purpose, providing an explanation of each step throughout the process. The demonstration took 4 1/2 minutes. A "User's Manual" is presented as Appendix "C" of the final report.

An open discussion followed from which the following comments emerged:

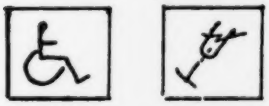
1) Wider velcro strips for container fastenings (2-2 1/2")
2) Larger opening and a greater number of handle straps to facilitate use with bulky mits in winter and permit end-to-end carriage by two persons as well as side-by-side.
3) Brighter general colour of canvas container for greater visibility (yellow, orange or red).
4) Lighten weight as much as possible through use of lighter gauge canvas or thinner-walled aluminum tubing.
5) Extend stiffeners more around bottom and top.
6) Canvas pocket not considered essential (use uncertain).
7) Have basic instructions for use stitched on outside.

/2...

8) Include transparent plastic pocket for O/D tag on outside (K. Sanford submitted JPBC Agenda Item 5 document and sketch as an example).
9) Include appropriate identification markings on container

e.g.

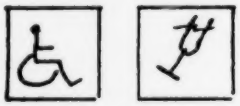
Transport Canada



one side

Colours: Black on yellow
Black on red

Transports Canada



opposite side

(small version)
(large version)

Tom Illing described the most common wheelchair damages resulting from normal handling by Air Canada and suggested that the container, with the chair inside, be dropped from waist height on its side and in its upright position.

Jim Nicklin obliged and following the two drop tests, one wheel rim was seen to be slightly damaged. The damage appeared to result from the upright test and was described by T. Illing as quite common and perhaps less severe than other chairs. Design comment # 5 was intended to offset this particular shortcoming of the container to the greatest extent possible.

The remainder of the discussion dealt with future direction of the project and is coverec under agenda item 5.

4. Kathleen Lauder of Hickling-Partners tabled a progress report on Service Contract No. 4453 and copies were distributed to members. She proceeded to summarize the results of the testing of the cardboard box container with CP Air. Results were quite discouraging with 20 of 50 containers not accounted for but only one response of a movement being reported. Problems are identified in the progress report but generally seem to indicate:

- low volume of wheelchair travellers at CP Air Ottawa
- staff unfamiliarity of container use or procedures
- complexity of test procedures and reporting.

/3...

T. Illing of Air Canada, when asked to participate in testing the box container, agreed. K. Lauder to coordinate the transfer of a quantity of containers to T. Illing for purposes of testing them over a period of about 4 weeks to be completed prior to testing of reuseable canvas containers. Results are to be documented in final report to complete the project.

5. The question of further work, specifically quantity reusable container fabrication and testing with one or both national airlines was then discussed and the committee recommended the following program after some discussion:

1) H-P to provide a single box container to R. Corkett at Tower 'C' and another one to W. Rowan at TDC office in Montreal from the original order of 50 for retention.
2) Davis and H-P to provide series of 35mm slides demonstrating the packaging of wheelchair into box container on a similar basis as the polaroid photos presented for the canvas bag container.
3) TDC to make necessary administrative arrangements to provide slide presentation material to K. Sanford or T. Illing for Geneva conference and allow Davis Engineering to continue the reusable container development into the test phase.
4) Adapt T. Illing's suggestion to extend the Davis container design configuration to accommodate the majority of the electric and rigid (non-collapsible) manual wheelchairs and fabricate another prototype model. (The Air Canada preferred solution would be to provide the larger container for all wheelchairs rather than attempt to maintain one model for each type).
5) Modify the canvas container design to overcome shortcomings itemized by committee members and fabricate a quantity of each model for test purposes.
6) Provide a quantity of up to five (5) canvas reusable containers to Air Canada (and CP Air or other Canadian airlines, as necessary) for a test period of 6-8 weeks, while keeping a separate control unit for Transport Canada, and monitor and report test results.
7) Adopt low-key, non-structured, information collection and feedback approach to container testing, as suggested by T. Illing, to overcome some of the reported shortcomings of the H-P/CP Air testing procedures.

The meeting was adjourned for lunch on the understanding that W. Rowan would coordinate the action items and attempt to get a contract in place to permit commencement of phase 4 before the end of February. The next meeting was tentatively scheduled for about the end of March 1982.

/4...

6. The afternoon session dealt with the status of related projects dealing with transportation of the handicapped including:

1) Air transport of wheelchair batteries by Air Canada.
2) IATA and ICAO regulation action.
3) Carrier interlining of battery packaging.
4) Narrow chair test activity - different models.
5) Access to Skies program.
6) Aircraft boarding project.
7) Electronic voice announcement systems.
8) Telidon application in airport information booths.

Progress on the first five items appeared promising with some further development action required within Transport Canada for the final three items.

The meeting adjourned at 15:00 hrs.

W.G. Rowan
Senior Development
Officer (Chairman)

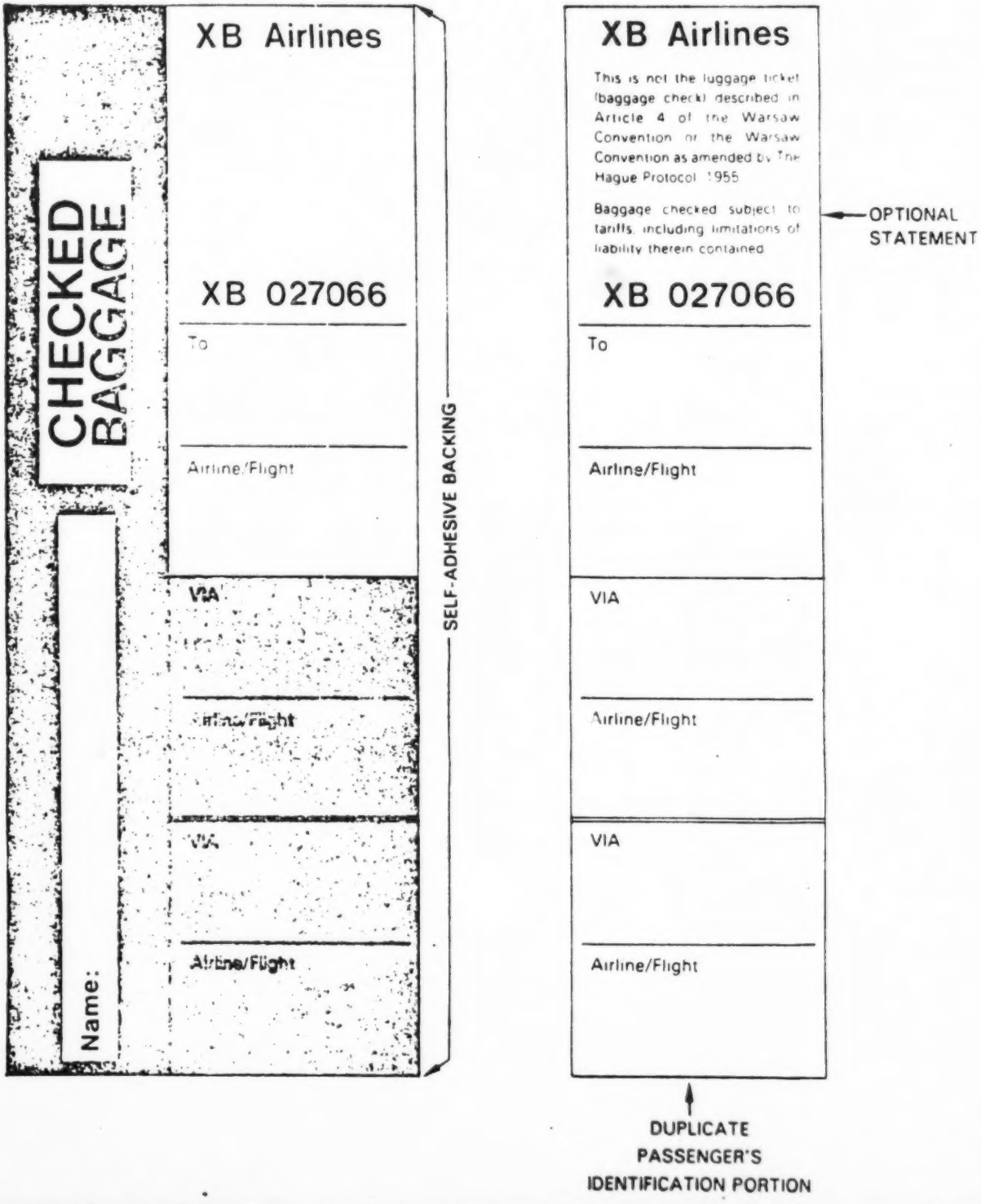
WGR/cb

cc: L. Suen
R. Nishizaki

740

ATTACHMENT 'B'

MANUALLY ISSUED SELF-SEAL TAG FOR BOXES, CARTONS, ETC.
(Revised)



Subject: MANUALLY ISSUED SELF-SEAL TAG FOR BOXES, CARTONS, ETC.

Submitted by: IATA Secretary

Background: The following is an extract from the October 1981 PBPC Minutes:

"Agenda Item 6: Manually Issued Self-Seal Tag for Boxes, Cartons, etc.

12. This item was submitted by the Secretary and contained a copy of Resolution 740, Attachment "B", the current Manually Issued Self-Seal Tag. As the format is now outdated, the Secretary suggested a tag similar to the Lufthansa, KLM and Air France tag. Each member was asked to bring acopy of their self-seal tag in the meeting.

13. A member stated that status of the resolution is contained in the text and that samples are not mandatory. Another member suggested we show an example to keep tags similar to the common tag. It was agreed that the secretary would design a new self-seal tag for approval at the next Joint ATC Baggage Task Force/PBPC Meeting."

Proposed Action: The design for the new self-seal label tag is shown in Attachment "C". If approved, it will be submitted to the next JPSC Meeting.

Explanation:

1. Design identical to 740c, except one extra pink transfer portion included for three flight legs.
2. Name box to conform with Resolution 741.
3. Checked Baggage added, to conform with RP1740c.
4. Information on tag and passenger's identification "top" portion line up for "crash printing".
5. May also be used for online. (white instead of pink transfer portions)

NB. The use of this tag will:

- eliminate "tag offs" on Group "X" articles
- reduce the number of Group "X" articles at Central Tracing Office.
- reduce the incidents of boxes mistaken for cargo.
- reduce lost baggage claims.

APPENDIX B

AIRLINES SURVEYED LIST

APPENDIX B

Betty-Ann Bennett
Manager Training Center
Nordair Limited
Montreal International Airport
CP 4000 AMF
Dorval, Quebec
(514) 636-5811

Paul Benoit
Manager Sales & Services
Eastern Airlines Inc.
Montreal International Airport
Dorval, Quebec
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Francine Gallazzo
Quebecair
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Dorval Airport
Dorval, Quebec
H4Y 1B5
(514) 636-3890

Kelly Woltz
Passenger Services Supervisor
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L5P 1A2
(416) 676-4090

Tom Illing
Baggage Services Manager
Air Canada
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Montreal International Airport
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(514) 636-7318

Mike Symington
Supervisor Facilitation and Procedure
CP Air
Vancouver International Airport
Vancouver, Canada
V7B 1V1
(604) 270-5211

Roger Wildfong
Passenger Services Manager
Air Ontario
Toronto International Airport
Box 201
Toronto AMF, Canada
L5P 1B2
(416) 676-2726

APPENDIX C

RESPONSES FROM C.P. AIR AND AIR CANADA ON IN-FIELD TESTS

CPAir

July 27, 1982

Mr. Jim Nicklin, P. Eng.
Davis Engineering
1481 Cyrville Road
Ottawa, Ont. K1B 3L7

Dear Jim:

Please accept my apologies for the delay in getting this to you, things have been very busy in the office. I will deal with the questions you listed in order and then add general comments on the wheelchair container.

1) It is difficult to state exactly how many uses the containers underwent. Four were used but probably not enough to qualify as a full test.

2) The containers did fit on the wheelchairs, however there was the occassional problem fastening the upper back strap.

3) The only noted problem with the container was that the back sometimes did not fully close and the footrests were vulnerable to falling out.

4) The container requires two people to put the wheelchair in. With practice little difficulty was discovered but without training it was difficult. Because the chair cannot be wheeled on the ramp handling was most awkward.

5) No damage was noted to wheelchairs, however this is normal as we very seldom damage them. One container slipped bars, another has some damage to the canvas caused by bars, plastic tips?

6) There seem to be too many straps and handles, however they all appear necessary in some aspects of loading/unloading and carrying. The rear closure needs improving.

....2

As stated in Number 1 and on the telephone I don't feel the test was fully conclusive in that we were unable to say that the container did in fact save a wheelchair from damage. In order to assess this properly, it would be necessary to move two wheelchairs around the country, one in a container and one out as a control. The difference in the deterioration between the two would then identify the effectiveness of the container.

Yours truly,

A.T.M. Symington
Manager
Airport Standards

AIR CANADA

Transportation Services, Dorval
P.O. Box 8000, Montreal International Airport, Montreal, Canada H4Y 1C3

Cable Aircanada
Telex 01-2613

September 2, 1982

Mr. J. Nicklin
Davis Engineering Limited
148 Cyrville Rd.
Ottawa, Ont.

Re Wheelchair Cover Tests August 20 to September 1, 1982.

The following information is a breakdown on test runs for two wheelchair bags conducted by Air Canada. Each bag received two test runs and due to the condition of the bags, it was felt by this office it would be beneficial for the Engineering Group to evaluate damages rather than continue running tests.

Test # 1 - Bag # 1 - Montreal - St. Johns Nfld.

Wheelchair left Baggage Services Office transported by truck to Dorval Airport, placed on board flight for carriage to St. Johns. Returned via same route St. Johns to Dorval and trucked to this office.

Inspection of bag revealed the following deficiencies:

* ribs protruding
* tear by rear access door

Test # 2 Bag # 1 - Montreal - Halifax

Forwarding procedures same as above. Wheelchair transported by truck to Dorval Airport for carriage to Halifax and returned same route.

Inspection on return revealed:

* top front carrying handle torn
* rip on bottom front
* tear on both sides caused by ribs

...contd.:

Test # 1 Bag # 2 - Montreal - Vancouver

Wheelchair transported by truck to Dorval airport for carriage by air to Vancouver and returned via same route.

Inspection on return revealed:

* tear on front
* front carrying handle torn

Test # 2 Bag # 2 - Montreal - Edmonton

Wheelchair handling procedures same as above, trucked to Dorval airport and forwarded to Edmonton and returned via same route.

Inspection on return revealed:

* additional 2 tears on front
* ribs protruding
* tear on side caused by rib

In summary:

The movement of the chair inside the bag may have contributed to the fabric deterioration. No evidence of damage to the wheelchair. The test for trip life is terminated due to the extensive wear and tear of the two test bags.

Please advise your recommendation re future tests.

T. Illing
Manager Baggage Services

APPENDIX D

SAMPLES OF INSTRUCTIONS PROVIDED ON EACH CONTAINER

INSTRUCTIONS:

1. Hold the container by the handle, release the two velcro straps, and unroll the container.
2. Using the top handle, hold the door of the container upright, push the wheelchair inside.
3. Place footrests and loose articles between the wheels of the wheelchair on the floor of the container.
4. Pass the elastic cord through the rope hook and latch into the ring stitched into the rear bottom.
5. Grip both central handles and sharply lift the container and wheelchair. Secure the two top velcro straps.
6. Tightly secure the three rear velcro strips to close the door.
7. Tightly secure the front velcro strip.

To unload, reverse the above procedures. Roll up the container and secure with the two velcro strips provided.

INSTRUCTIONS:

1. Tenez le sac par l'anse, relâchez les deux bandes de velcro, et déroulez le sac.
2. Ouvrez la porte d'accès du sac, et roulez le fauteuil roulant dedans.
3. Mettez les articles libres sur le fond du container entre les roues du fauteuil roulant.
4. Passez la corde élastique a travers le crochet sur la corde, et l'accrocher à l'anneau au fond du sac.
5. Tenez les deux anses au centre du sac, les enlevées rapidement et attachez les deux velcros au dessus.
6. Fermez la porte en arrière avec les trois bandes de velcros.
7. Attachez la bande de velcro en avant du sac.

Pour décharger le container, renversez les instructions au dessus.